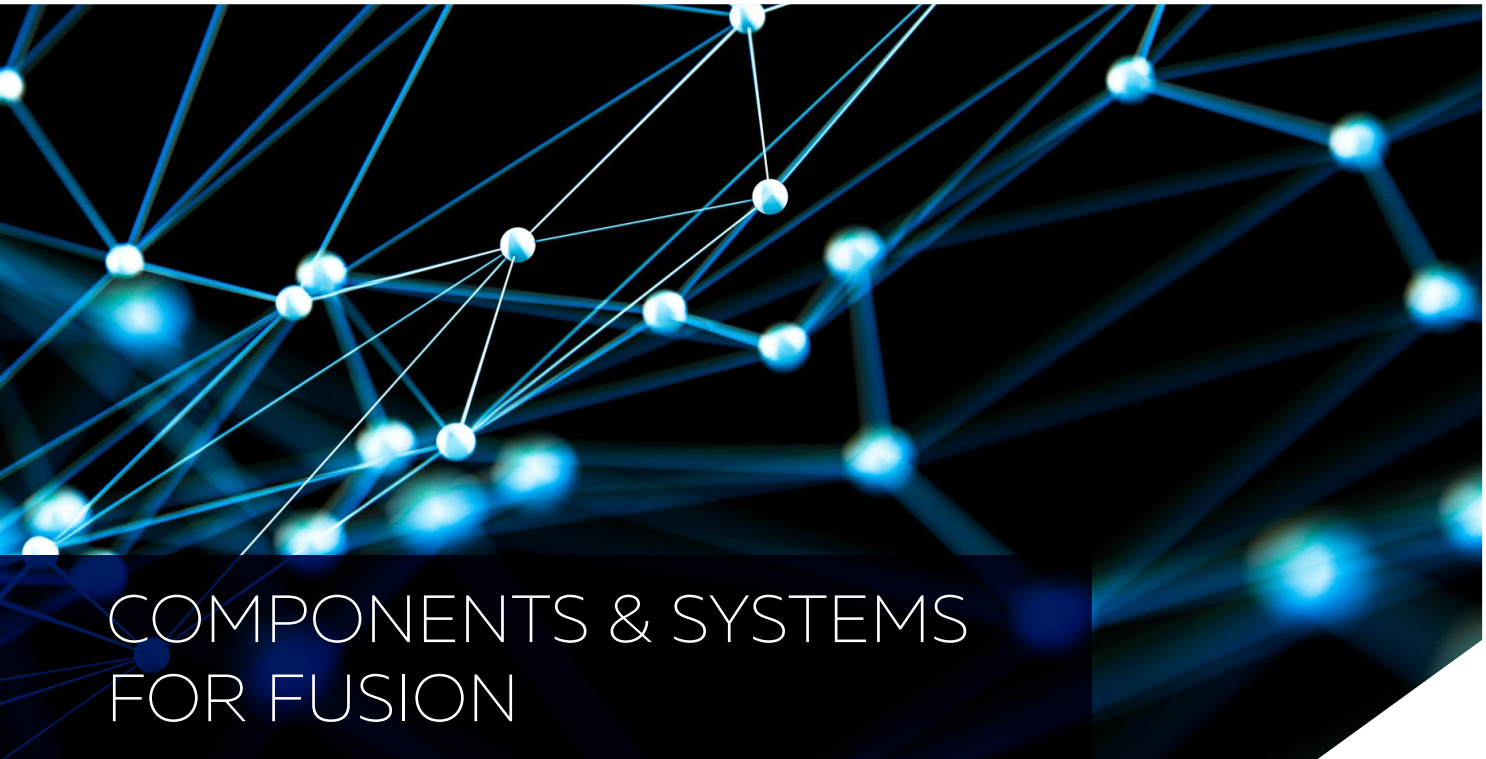
FUSION



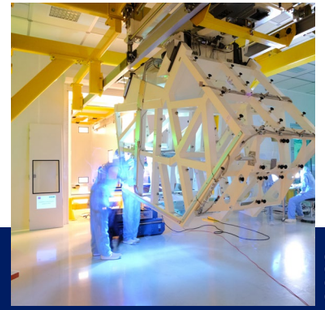
COMPONENTS & SYSTEMS FOR FUSION

Inertial and magnetic confinement:
our expertise in support of a new energy

CNIM
Systèmes Industriels

Large-scale components and systems for **energy production**.

For nearly 30 years, CNIM Systèmes Industriels (CSI) has been providing its expertise in inertial and magnetic confinement fusion.



Compliance with safety requirements
CSI manufactures classified components and systems to meet major nuclear safety challenges. We meet these challenges. For example, we guarantee that our equipment maintains confinement properties, reduces operator exposure, can resist earthquakes- and is extremely reliable even in operating in degraded mode.

Quality control: process & culture
The combination of a strong internal quality control process (ISO 19443 expected by November 2022), a nuclear safety culture and 20 years of experience in Fusion technology makes CSI a trusted partner.

Codes and standards
Our products comply with the most stringent nuclear or other standards (RCCM, ESPN, CODAP, ASME, etc.) and meet the requirements of the nuclear safety authorities.

KEY FIGURES 2022
CNIM SYSTEMES INDUSTRIELS

400
EMPLOYEES

INCLUDING
150
ENGINEERS AND TECHNICIANS

€74 million
ANNUAL TURNOVER

ISO 9001
ISO 19443

30 years
IN FUSION TECHNOLOGY

46,000 sqm
OF WORKSHOPS

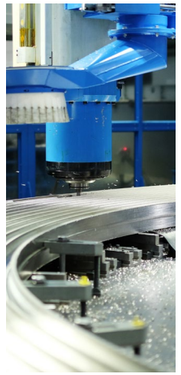
2,700 sqm
OF CLEAN ROOMS

Our historical know-how

1. Industrialisation, manufacturing and inspection of large mechanical components (from 2 to 20 m).

MACHINING OF LARGE COMPONENTS

Turning, boring and milling of very large components; high speed milling Stainless steel, aluminium, AG3NET and noble metals



METROLOGY

Ensuring manufacturing tolerances: a few µm in components measuring several metres in dimension. Accuracy: ISO 10360-2-5 E0/E150 compliance

WELDING & INSPECTION

Our teams are qualified up to COFREND 3, the highest level.
Electron beam welding is one of our specialities.

INNOVATIVE PROCESSES

Constant effort to develop new processes : HIP, diffusion bonding, flow forming...

MATERIALS EXPERTISE

Polyurethane Composites: pultrusion winding, dry machining, impregnation, filament winding, etc.

2. Design & production of complex systems for harsh environments.
Around a hundred engineers and technicians in our design office can design and industrialise your products.
/ Calculation, modelling and simulation
/ Design & mechanical integration, I&C and hydraulics
/ Cleanliness management
/ Radiation protection and ALARA approach
/ Supply Chain Management

3. Clean room integration
Two clean rooms for cleaning, assembly, testing and qualifying parts requiring a very high level of cleanliness.
Both are equipped with large, integrated washing equipment.

/ 2,700 sqm of rooms (cleaning class ISO 5 to ISO 8).

2 700 sqm of white and grey rooms

MEETING THE QUALITY REQUIREMENTS OF OUR CUSTOMERS

CSI, with over 30 years of experience in fusion technology (Megajoule Laser, West and ITER) and 50 years in French nuclear power and the Deterrent force, provides cutting-edge know-how and exceptional rigour.

Active throughout the entire manufacturing chain, from design to on-site qualification and installation, CSI vertically integrates your projects.

/ Vertical integration

/ Nuclear safety culture

/ Manufacturing codes and standards

Our manufacturing and metrology resources are designed and built to handle large dimensions and perfect for ensuring the quality of the parts leaving our workshops.

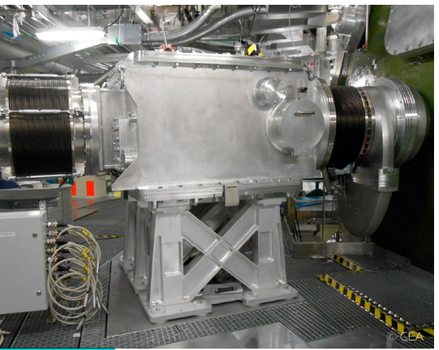
Inertial confinement: our offer and references

CSI is involved in Megajoule Laser program since 1990 as project manager for important workpackages. The company has extensive experience in clean environments.

Cleanliness, precision and performance

Our teams know how to design and manufacture high-precision mechanical and optical components operating in ultra-clean environments.

To meet the cleanliness challenges of power lasers and ensure that the required performance is achieved, we qualify our products on custom, full-scale test benches.



Vacuum transport line (delivered turnkey) for the very high energy PETAL laser

REMOTELY OPERATED HANDLING SYSTEMS

Our remotely operated heavy load handling systems can meet exceptional performance requirements.

PROCESS EQUIPMENT

With our process equipment, which integrates the constraints of supported optics, sensors and provides an ultra-clean environment and the required precision, scientific experiments are sure to run smoothly.

ULTRA-STABLE MECHANICALLY WELDED STRUCTURES

ALARA approach, cleanliness, electromagnetic compatibility, assembly in a clean room, etc. Like all our products, our dedicated structures with optical components are reliable and safe.

VACUUM CHAMBERS

Designed for ultra-clean environments under high-vacuum conditions, our vacuum chambers can house optical and opto-mechanical systems.

MEGAJOULE LASER: REMOTELY OPERATED VEHICLE FOR THE SAFE HANDLING OF CONTAMINATED & ACTIVATED PARTS

/ Support for operations and maintenance of the equipment in the Megajoule Laser Experimental Hall

/ Load capacity: 7 tonnes

/ Remotely operated.

Diagnostic insertion system for inserting various types of plasma diagnostics in the Megajoule Laser project. The remotely-controlled diagnostic insertion systems operate under vacuum conditions

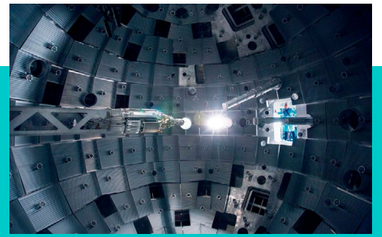
Handling system for the Megajoule Laser Frequency and Focusing Conversion System for positioning mirrors to within a few µm; ISO7 compatible and capable of bearing loads of several tonnes.

PCNC:
Non Cryogenic Target positioning system

14.5 m deployed
8.5 M RETRACTED
1 M DIAMETER

4 tonnes

3 µm precision
POSITIONING THE MEGAJOULE LASER TARGET



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Magnetic confinement: our offer and references

Through our extensive experience with ITER, with more than 20 contracts completed or in progress, the CNIM Systèmes Industriels teams can meet the challenges of other Tokamaks.

Assembly, operation and maintenance

Our magnetic confinement fusion expertise and products cover Tokamak assembly with our heavy component handling systems, the manufacture of Tokamak components and the Tokamak operation or handling phases.
Our teams have a nuclear safety culture, and all our products meet the strictest requirements.

Handling the heaviest ITER component, the cryostat base weighing 1250 tonnes.

REMOTE HANDLING SYSTEMS

Moving components ranging from several tons to millimetres in size safely and with complex kinematics, our systems can be used for Tokamak assembly.

DIVERTORS

Highly robust, reliable and play a key role in operations. our divertors are produced using special manufacturing processes to ensure they meet the constraints of neutron fluxes and extreme temperatures.

SUPERCONDUCTING MAGNETS AND MECHANICAL COIL COMPONENTS

CSI manufactures superconducting magnets and their assemblies, drawing on our mastery of materials (metals & composites) and the qualification of special manufacturing processes.

CRITICAL COMPONENTS FOR VACUUM CHAMBERS

Our large components in highly resistant alloys are reliable and comply with nuclear codes and standards (RCC-MR, etc.) They are manufactured in a clean environment to guarantee their operation.

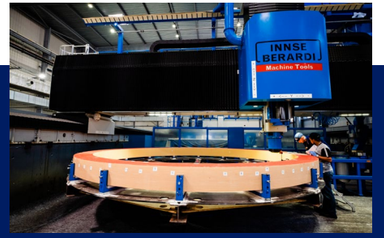
IN-VESSEL TOWER CRANE (IVTC) - ITER
/ Handling equipment used for the initial assembly in vessel components
/ Confined working space
/ Millimetre accuracy achieved


Series production of 35 ITER toroidal field coil radial plates using electron beam welding under local vacuum.

ITER Tokamak's Divertor cassette body prototype
3.3x2.5x0.8 m – 316LN & XM-19

Pre-compression Rings (series of 10)
Composite rings in epoxy fibreglass

For the ITER core
5 m in diameter
WINDING AND BONDING OF COMPOSITE PULTRUTED MATERIAL, A WORLD PIONEERING PROCESS
3.4 tonnes
Withstands 24 tonnes of radial force
LONG SERVICE LIFE AND 4 KELVIN OPERATION



Dry machining and dimensional checks

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